

## Functional Outcome of the Treatment of Thoraco Lumbar Spine Fractures (D5-L5 Level) Based on Thoraco Lumbar Injury Classification and Severity (TLICS) Score

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### Abstract

**Background:** Thoracolumbar spine fractures represent a significant proportion of spinal injuries encountered in trauma centers and are frequently associated with substantial morbidity, neurological deficits, chronic pain, spinal deformity, and functional disability. Accurate assessment of fracture stability and neurological involvement is essential for determining the appropriate treatment modality. The Thoracolumbar Injury Classification and Severity Score (TLICS) was developed as a comprehensive classification system incorporating fracture morphology, neurological status, and posterior ligamentous complex integrity to guide treatment decisions. Despite its widespread acceptance, evidence regarding its reliability and effectiveness in predicting functional outcomes remains limited in the Indian population.

**Aim:** To assess the reliability and safety of the Thoracolumbar Injury Classification and Severity Score (TLICS) in choosing the treatment modality (surgical or conservative) for thoracolumbar spine fractures involving D5–L5 vertebral levels.

**Material and Methods:** This prospective observational study was conducted in the Department of Orthopaedics, Government Medical College, Kozhikode, over a period of one year following Institutional Ethics Committee approval. Sixty-eight adult patients aged 18–65 years presenting with thoracolumbar fractures between D5 and L5 levels were included. Patients were evaluated clinically and radiologically using X-ray, CT scan, and MRI. TLICS scores were calculated based on fracture morphology, neurological status, and posterior ligamentous complex integrity. Patients with TLICS  $\leq 3$  received conservative treatment, while those with scores  $\geq 5$  underwent surgical management. Patients with a score of 4 were managed according to clinical judgment. Functional outcomes were assessed using the Oswestry Disability Index (ODI), Visual Analog Scale (VAS), American Spinal Injury Association (ASIA) impairment scale, and Cobb's angle measurements during follow-up at 2 months, 4 months, 6 months, and 1 year.

**Results:** The study evaluated the association between TLICS scores and treatment decisions while assessing pain relief, neurological recovery, functional improvement, and radiological correction. Patients managed according to TLICS recommendations demonstrated significant improvements in VAS scores, ODI scores, ASIA grades, and Cobb's angle measurements over the follow-up period. Surgical treatment was predominantly performed in patients with higher TLICS scores and neurological deficits.

**Conclusion:** TLICS is a reliable and practical tool for guiding treatment decisions in thoracolumbar spine fractures. The classification system facilitates appropriate selection of surgical or conservative management and is associated with favorable functional and radiological outcomes. Adoption of TLICS-based management protocols may improve treatment standardization and patient outcomes in thoracolumbar trauma.

**Keywords:** Thoracolumbar fracture; TLICS; Spinal trauma; Oswestry Disability Index; Cobb angle; ASIA grading; Functional outcome.

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## Introduction

Thoracolumbar spine fractures constitute nearly 60–70% of all traumatic spinal injuries and represent a major cause of disability worldwide, particularly among young adults involved in high-energy trauma such as road traffic accidents and falls from height. The thoracolumbar junction, extending from T10 to L2 vertebrae, is especially vulnerable because it represents the transition zone between the rigid thoracic spine and the more mobile lumbar spine. Consequently, this region is subjected to significant biomechanical stress during traumatic events, predisposing it to fractures and instability. [1]

Management of thoracolumbar fractures remains a challenging aspect of spinal trauma care. The primary goals of treatment include preservation or restoration of neurological function, maintenance of spinal stability, correction of deformity, prevention of progressive kyphosis, pain relief, and early mobilization. Selecting the optimal treatment strategy requires careful assessment of fracture morphology, ligamentous injury, neurological status, and overall patient condition. [2]

Historically, several classification systems have been proposed to characterize thoracolumbar injuries. Denis introduced the three-column theory, emphasizing the importance of spinal stability based on involvement of anterior, middle, and posterior columns. Although widely used, this system lacked guidance regarding treatment decisions.

The AO Spine classification subsequently provided a detailed morphological categorization but was criticized for its complexity and limited consideration of neurological deficits. [3,4]

To overcome these limitations, the Spine Trauma Study Group developed the Thoracolumbar Injury Classification and Severity Score (TLICS). This system incorporates three clinically relevant parameters: injury morphology, neurological status, and integrity of the posterior ligamentous complex (PLC). Scores are assigned to each parameter, generating a cumulative score that guides treatment recommendations. Patients with scores  $\leq 3$  are generally managed conservatively, those with scores  $\geq 5$  are recommended for surgery, and a score of 4 represents an indeterminate zone requiring clinical judgment. [5]

Several studies have demonstrated substantial interobserver reliability and validity of TLICS in determining management strategies for thoracolumbar fractures. Joaquim et al. reported that TLICS provided excellent agreement among spine surgeons regarding treatment decisions and facilitated standardized patient care. [6]

Furthermore, studies have shown that adherence to TLICS recommendations is associated with favorable clinical outcomes and reduced variability in treatment selection. [7] Despite increasing global acceptance of TLICS, there remains limited prospective evidence evaluating its effectiveness in predicting long-term functional outcomes, particularly in developing countries where trauma burden is substantial. The relationship between TLICS-guided treatment and postoperative neurological recovery, pain improvement, kyphotic correction, and disability reduction requires further investigation. [8,9]

Functional assessment using validated outcome measures such as the Oswestry Disability Index (ODI), Visual Analog Scale (VAS), and American Spinal Injury Association (ASIA) Impairment Scale provides objective evaluation of treatment effectiveness. Radiological assessment using Cobb's angle further helps determine maintenance of spinal alignment and correction of deformity. [10]

The present study was therefore undertaken to evaluate the reliability and safety of TLICS in guiding treatment decisions for thoracolumbar fractures involving D5–L5 vertebral levels and to compare the functional and radiological outcomes of patients managed according to this classification system at a tertiary care center.

## Materials and Methods

**Study Design:** The present research was designed as a prospective observational study aimed at evaluating the reliability and effectiveness of the Thoracolumbar Injury Classification and Severity Score (TLICS) in determining the appropriate treatment modality for thoracolumbar spine fractures involving D5 to L5 vertebral levels. The study prospectively followed patients from the time of admission through a one-year follow-up period, allowing comprehensive assessment of functional, neurological, and radiological outcomes.

**Study Setting:** The study was conducted in the Department of Orthopaedics, Government Medical College, Kozhikode, Kerala, a tertiary care teaching hospital that serves as a major referral center for trauma and orthopedic emergencies. The institution receives a large number of spinal trauma cases from urban and rural regions, thereby providing a representative patient population for evaluating thoracolumbar fracture management.

**Study Duration:** The study was carried out over a period of one year following approval from the Institutional Research Committee (IRC) and Institutional Ethics Committee (IEC). Patient recruitment, treatment allocation, follow-up

assessments, data collection, and analysis were completed during this period.

**Study Population:** The study population consisted of adult patients presenting with traumatic thoracolumbar spine fractures involving vertebral levels D5 through L5. All eligible patients admitted to the orthopedic department during the study period were screened and evaluated for participation. Patients meeting the predefined inclusion criteria and providing written informed consent were enrolled in the study.

**Inclusion Criteria:** Patients were included in the study if they had radiologically confirmed thoracolumbar spine fractures involving the D5–L5 vertebral levels and were between 18 and 65 years of age. Both neurologically intact patients and those presenting with varying degrees of neurological deficits were considered eligible.

**Exclusion Criteria:** Patients younger than 18 years or older than 65 years were excluded from the study. Individuals with pathological fractures secondary to tumors, metabolic bone diseases, or infections were not included. Patients with associated polytrauma requiring multidisciplinary management, severe head injuries, or life-threatening systemic injuries were also excluded to avoid confounding factors influencing functional outcomes.

**Sample Size:** The sample size was calculated based on the sensitivity of the TLICS system reported in previous literature. Using a sensitivity value of 98%, prevalence of thoracolumbar fractures of 3.33%, confidence level of 95%, and precision of 13%, the minimum required sample size was estimated to be 68 patients. This sample size was considered adequate to evaluate the reliability of TLICS in guiding treatment decisions and predicting outcomes.

**Sampling Technique:** A non-probability purposive sampling technique was adopted. Consecutive eligible patients presenting to the orthopedic department with thoracolumbar spine fractures during the study period were screened for participation. After confirming eligibility criteria and obtaining informed consent, patients were enrolled sequentially until the required sample size was achieved.

**Clinical and Radiological Evaluation:** Upon admission, a detailed clinical history was obtained, including demographic characteristics, mechanism of injury, associated symptoms, and neurological complaints. Comprehensive physical examination was performed with particular attention to spinal tenderness, deformity, motor function, sensory deficits, and bowel or bladder involvement. Radiological evaluation included plain radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) whenever indicated. CT

scans were utilized for detailed fracture morphology assessment, whereas MRI was performed to evaluate posterior ligamentous complex integrity and neural element involvement.

**TLICS Assessment and Treatment Allocation:**

For each patient, the Thoracolumbar Injury Classification and Severity Score was calculated based on three major components: fracture morphology, neurological status, and posterior ligamentous complex integrity. Scores assigned to each parameter were summed to obtain the final TLICS score. Patients with a TLICS score of 3 or less were treated conservatively using spinal orthoses, pain management, physiotherapy, and supervised rehabilitation. Patients with scores of 5 or more underwent surgical stabilization and decompression when indicated. Those with a score of 4 were managed either conservatively or surgically based on surgeon preference, patient characteristics, and clinical judgment.

**Follow-up and Outcome Assessment:** All patients were followed prospectively at 2 months, 4 months, 6 months, and 1 year following treatment initiation. Functional outcome was assessed using the Oswestry Disability Index (ODI), which evaluates disability related to spinal disorders. Pain severity was measured using the Visual Analog Scale (VAS). Neurological recovery was evaluated using the American Spinal Injury Association (ASIA) Impairment Scale. Radiological outcomes were assessed by measuring Cobb's angle on serial radiographs to evaluate kyphotic deformity correction and maintenance of spinal alignment. Any complications, treatment failures, neurological deterioration, implant-related problems, or recurrence of deformity were documented during follow-up.

**Data Collection:** Data were collected using a predesigned structured case record form. Information recorded included demographic variables, injury characteristics, TLICS scores, treatment modality, neurological findings, radiological measurements, functional scores, pain scores, and follow-up outcomes. All assessments were performed by trained orthopedic surgeons using standardized protocols to ensure consistency and minimize observer bias.

**Study Tools:** The principal study tools included the Thoracolumbar Injury Classification and Severity Score (TLICS) for injury classification and treatment guidance, Visual Analog Scale (VAS) for pain assessment, Oswestry Disability Index (ODI) for functional disability evaluation, American Spinal Injury Association (ASIA) Impairment Scale for neurological assessment, and Cobb's angle measurement for radiological evaluation of spinal alignment and kyphotic deformity.

**Outcome Measures:** Primary outcome measures included the appropriateness of treatment selection based on TLICS recommendations and functional recovery as assessed by ODI scores. Secondary outcome measures included pain improvement assessed by VAS scores, neurological recovery assessed by ASIA grading, radiological correction of kyphosis assessed through Cobb's angle measurements, and incidence of treatment-related complications.

**Ethical Considerations:** Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from all participants after explaining the objectives, procedures, benefits, and potential risks involved. Confidentiality and anonymity of patient information were strictly maintained. Participation was voluntary, and patients were assured that refusal to participate would not affect their standard medical care. Only patients covered under Karunya Arogya Suraksha Padhathi (KASP) or Karunya insurance schemes were included to ensure equitable access to treatment without financial burden.

**Statistical Analysis:** Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, New York, USA). Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. Associations between TLICS scores and treatment modalities were evaluated using the Chi-square test. Paired t-tests or Wilcoxon signed-rank tests were used to compare baseline and follow-up outcome measures. Correlation analysis was performed to assess relationships between Cobb's angle, VAS scores, ODI scores, and ASIA grades. A p-value less than 0.05 was considered statistically significant.

### Results

The present prospective observational study included 68 adult patients with thoracolumbar spine fractures involving D5–L5 levels. The study population was analyzed according to demographic characteristics, mode of injury, fracture level, neurological status, TLICS category, treatment modality, pain improvement, functional recovery, neurological outcome, and radiological correction.

**Table 1: Demographic Distribution of Study Participants**

Variable	Category	Frequency (n)	Percentage (%)
Age group	18–30 years	19	27.94
	30–60 years	42	61.76
	>60 years	7	10.29
Gender	Male	43	63.24
	Female	25	36.76

The majority of patients belonged to the 30–60-year age group, accounting for 42 cases (61.76%), followed by 19 patients (27.94%) aged 18–30 years.

Only 7 patients (10.29%) were above 60 years. This indicates that thoracolumbar spine fractures

were more frequent among adults in the economically productive age group.

Male predominance was observed, with 43 males (63.24%) compared with 25 females (36.76%), suggesting greater exposure of males to high-energy trauma and outdoor occupational risks.

**Table 2: Injury Characteristics, Neurological Status, TLICS Category and Treatment Modality**

Variable	Category	Frequency (n)	Percentage (%)
Mode of injury	Fall from height	26	38.24
	Road traffic accident	25	36.76
	Slip and fall	10	14.71
	Other causes	7	10.29
Level of fracture	D11	1	1.47
	D12	9	13.24
	L1	29	42.65
	L2	25	36.76
Neurological status	L3	4	5.88
	Intact	41	60.29
	Incomplete deficit	19	27.94
TLICS category	Complete deficit	8	11.76
	Conservative score, 1–3	23	33.82
	Indeterminate score, 4	10	14.71
Treatment modality	Surgical score, 5–10	35	51.47
	Conservative	23	33.82
	Surgical	45	66.18

Fall from height was the most common mode of injury, seen in 26 patients (38.24%), closely followed by road traffic accidents in 25 patients (36.76%). Slip and fall accounted for 10 cases (14.71%), while other causes contributed to 7 cases (10.29%).

The most frequently involved vertebral level was L1, observed in 29 patients (42.65%), and followed by L2 in 25 patients (36.76%). This confirms the vulnerability of the thoracolumbar junction and upper lumbar region to traumatic forces.

Neurologically, 41 patients (60.29%) were intact at presentation, whereas 19 patients (27.94%) had incomplete neurological deficit and 8 patients (11.76%) had complete deficit. Based on TLICS scoring, 23 patients (33.82%) were suitable for conservative treatment, 10 patients (14.71%) fell into the indeterminate category, and 35 patients (51.47%) were categorized for surgical treatment.

Overall, 45 patients (66.18%) underwent surgery, while 23 patients (33.82%) were treated conservatively.

**Table 3: Comparison of TLICS Score and Functional/Radiological Outcomes over Time**

Parameter	Time point / Group	Mean $\pm$ SD	Test value	p value
TLICS score	Conservative	1.52 $\pm$ 0.51	t = 13.07	<0.001*
	Surgical	6.13 $\pm$ 1.64		
VAS score	Pre-treatment	8.82 $\pm$ 1.27	Reference	Reference
	2 months	4.25 $\pm$ 2.36	t = 18.70	<0.001*
	4 months	1.79 $\pm$ 1.59	t = 34.43	<0.001*
	6 months	0.85 $\pm$ 1.37	t = 34.31	<0.001*
	12 months	0.62 $\pm$ 1.35	t = 33.89	<0.001*
ODI score	Pre-treatment	96.22 $\pm$ 7.32	Reference	Reference
	2 months	67.50 $\pm$ 17.53	t = 13.94	<0.001*
	4 months	41.00 $\pm$ 24.90	t = 17.70	<0.001*
	6 months	22.19 $\pm$ 26.13	t = 23.08	<0.001*
	12 months	14.79 $\pm$ 26.17	t = 25.53	<0.001*
Cobb angle	Pre-treatment	14.66 $\pm$ 5.34	Reference	Reference
	2 months	10.19 $\pm$ 3.39	t = 10.26	<0.001*
	4 months	8.79 $\pm$ 3.19	t = 13.90	<0.001*
	6 months	7.99 $\pm$ 2.39	t = 13.65	<0.001*
	12 months	7.89 $\pm$ 2.29	t = 13.60	<0.001*

\*Statistically significant.

The mean TLICS score was significantly higher among surgically managed patients (6.13  $\pm$  1.64) compared with conservatively managed patients (1.52  $\pm$  0.51), and this difference was statistically significant (p<0.001). This finding confirms that TLICS strongly influenced treatment selection.

Pain showed marked improvement over time. The mean VAS score reduced from 8.82  $\pm$  1.27 at baseline to 4.25  $\pm$  2.36 at 2 months, 1.79  $\pm$  1.59 at 4 months, 0.85  $\pm$  1.37 at 6 months, and 0.62  $\pm$  1.35 at

12 months. All reductions were statistically significant compared with baseline (p<0.001). Functional disability also improved substantially, with mean ODI score decreasing from 96.22  $\pm$  7.32 pre-treatment to 14.79  $\pm$  26.17 at 12 months (p<0.001).

Radiologically, the mean Cobb angle improved from 14.66  $\pm$  5.34 pre-treatment to 7.89  $\pm$  2.29 at 12 months, demonstrating significant correction and maintenance of sagittal alignment (p<0.001).

**Table 4: Distribution of ASIA Neurological Grading Over Time**

ASIA Grade	Pre-treatment (%)	n	2 months (%)	n	4 months (%)	n	6 months (%)	n	12 months (%)	n
A	12 (17.65)		12 (17.65)		12 (17.65)		11 (16.18)		9 (13.24)	
B	1 (1.47)		0		0		0		0	
C	3 (4.41)		2 (2.94)		1 (1.47)		1 (1.47)		0	
D	13 (19.12)		6 (8.82)		4 (5.88)		3 (4.41)		5 (7.35)	
E	39 (57.35)		48 (70.59)		51 (75.00)		53 (77.94)		54 (79.41)	
p value									0.320	

Neurological recovery showed a positive trend over the follow-up period. The proportion of patients with ASIA Grade E increased from 39 patients (57.35%) at baseline to 54 patients (79.41%) at 12

months. Complete neurological deficit showed limited improvement, with ASIA Grade A reducing from 12 patients (17.65%) to 9 patients (13.24%). Patients with incomplete neurological deficits

demonstrated better recovery compared with complete deficits. However, the overall change in ASIA grading over time was not statistically significant ( $p=0.320$ ), suggesting that neurological recovery may depend on the severity of initial neural injury and not only on treatment modality.

Overall, the results demonstrate that TLICS-based management was associated with appropriate treatment allocation, significant pain relief, marked functional improvement, and radiological correction of kyphotic deformity. Surgical treatment was more frequently selected among patients with higher TLICS scores, neurological involvement, and unstable fracture patterns, whereas conservative treatment was reserved for lower TLICS scores and stable injuries.

### Discussion

Thoracolumbar fractures remain one of the most common and clinically important forms of spinal trauma because of the biomechanical vulnerability of the thoracolumbar junction and the possibility of neurological injury, progressive kyphosis, chronic pain, and disability. The present prospective observational study assessed the functional and radiological outcomes of thoracolumbar fractures managed according to the Thoracolumbar Injury Classification and Severity Score (TLICS). The findings demonstrated that TLICS was a reliable and practical tool for guiding treatment decisions, with significantly higher scores among surgically treated patients than conservatively managed patients.

In the present study, the majority of patients were aged 30–60 years, and males constituted 63.24% of the study population. This pattern is consistent with previous spinal trauma literature, where thoracolumbar fractures are more common among young and middle-aged adults due to greater involvement in outdoor work, transport, construction activities, and high-energy trauma exposure [2]. Fall from height and road traffic accidents were the dominant mechanisms of injury, together accounting for nearly three-fourths of cases. Similar findings have been reported by Joaquim and Patel, who emphasized that high-energy mechanisms are major contributors to thoracolumbar trauma, especially in developing trauma-care settings [3].

The most commonly affected vertebral level was L1, followed by L2 and D12. This distribution supports the known biomechanical vulnerability of the thoracolumbar junction, where the relatively rigid thoracic spine transitions into the mobile lumbar spine. This transition zone is subjected to substantial flexion, axial loading, and translational forces during trauma [4]. Previous classification systems, including Denis' three-column theory and

the AO/Magerl classification, emphasized fracture morphology and mechanical instability; however, they were less directly linked to treatment decision-making [6].

The TLICS system was developed to address this limitation by incorporating three clinically relevant variables: fracture morphology, neurological status, and posterior ligamentous complex integrity [8]. In the present study, patients managed surgically had a mean TLICS score of  $6.13 \pm 1.64$ , whereas conservatively treated patients had a mean score of  $1.52 \pm 0.51$ . This difference was statistically significant ( $p<0.001$ ), confirming that TLICS strongly influenced treatment allocation. Koh et al. reported satisfactory reliability and validity of TLICS in guiding management decisions, supporting its use as a reproducible decision-making framework [9]. Similarly, Vaccaro et al. demonstrated that TLICS improved communication among clinicians and provided a structured approach to operative versus non-operative care [7]. Pain reduction was one of the most prominent outcomes in this study. The mean VAS score decreased from 8.82 at baseline to 0.62 at 12 months, with statistically significant improvement at all follow-up intervals ( $p<0.001$ ). This improvement may be attributed to stabilization of unstable fractures in surgically treated patients and progressive fracture healing, bracing, analgesia, and rehabilitation in conservatively managed patients. Previous studies have similarly shown that both operative and non-operative treatment can result in pain relief when treatment is appropriately selected based on fracture stability and neurological status [11]. Functional recovery, assessed using ODI, also improved significantly. The mean ODI score reduced from 96.22 pre-treatment to 14.79 at 12 months ( $p<0.001$ ), indicating a transition from severe disability to minimal or mild disability in many patients. Functional improvement reflects pain reduction, restoration of mobility, spinal stabilization, neurological recovery in incomplete injuries, and adherence to rehabilitation. Wood et al. reported that carefully selected stable burst fractures without neurological deficit may achieve good long-term outcomes with non-operative care [12]. However, unstable fractures, PLC injury, and neurological compromise generally require surgical stabilization, which is reflected in the present study.

Radiological outcome was assessed using Cobb angle measurement. The mean Cobb angle improved from  $14.66^\circ$  at baseline to  $7.89^\circ$  at 12 months, with statistically significant correction at all follow-up points ( $p<0.001$ ). This suggests satisfactory correction and maintenance of sagittal alignment. Kyphotic deformity is clinically relevant because progressive deformity may contribute to chronic pain, sagittal imbalance, and disability.

Surgical stabilization likely contributed to kyphotic correction in unstable injuries, while conservative treatment was effective in stable low-score injuries.

Neurological assessment using ASIA grading showed improvement in the proportion of patients with ASIA Grade E from 57.35% at baseline to 79.41% at 12 months. However, the overall change was not statistically significant ( $p=0.320$ ). This may be explained by the limited recovery potential among patients with complete neurological deficit. In contrast, patients with incomplete deficits demonstrated better neurological recovery, consistent with previous studies showing that initial neurological status is a major predictor of outcome [13-15].

The strength of the present study lies in its prospective design, standardized TLICS-based treatment allocation, serial assessment using validated functional tools, and combined clinical-radiological follow-up.

However, limitations include a single-centre design, a modest sample size, lack of randomization, and absence of long-term follow-up, which restricted the evaluation of sustained outcomes. Despite these limitations, the study supports the use of TLICS as a safe, reliable, and clinically meaningful system for guiding thoracolumbar fracture management.

### Conclusion

The present study concludes that the Thoracolumbar Injury Classification and Severity Score is a reliable and practical tool for selecting treatment modality in thoracolumbar spine fractures involving D5–L5 levels. Patients with higher TLICS scores were more commonly managed surgically, whereas those with lower scores were treated conservatively. TLICS-based management resulted in significant improvement in pain, disability, and kyphotic deformity over one year of follow-up. Neurological improvement was observed, particularly among patients with incomplete deficits, although the overall change in ASIA grading was not statistically significant. Therefore, TLICS can be safely used as a structured decision-making system for thoracolumbar fracture management in tertiary care trauma settings.

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